EPA/600/R-02/094
September, 2002

Demonstration of the HiPOx Advanced Oxidation Technology for the Treatment of MTBE-Contaminated Groundwater

Final Report

By

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The information in this document has been funded by the U.S. Environmental Protection Agency under Contract No. 68-C-00-181 to Tetra Tech EM Inc. It has been subject to the Agency's peer and administrative reviews and has been approved for publication as an EPA document. The results described herein should not be interpreted as USEPA policy or guidance. Mention of trade name or commercial products does not constitute endorsement or recommendation for use by the US Government.

Foreword

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
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Abstract

The HiPOx technology is an advanced oxidation process that incorporates high-precision delivery of ozone and hydrogen peroxide to chemically destroy organic contaminants with the promise of minimizing bromate formation. A MTBE-contaminated groundwater from the Ventura County Naval Base in Port Hueneme, CA was used to evaluate this technology. Due to extremely high concentrations of bromide in the feed water (1.3 mg/L) and the desire to limit bromate formation, an experimental system was operated with 630 ozone injector ports in series. In all trials, the HiPOx system reduced MTBE from 748 µg/L to below its regulatory limit of 5 µg/L; however, bromate was not maintained below its regulatory limit of 10 µg/L. The oxidative intermediate tert-butyl alcohol (TBA) was below its regulatory effluent limit of 12 µg/L in two of the three trials. Both MTBE and bromate were under their regulatory limits at intermediate sampling ports that corresponded to 330, 470, and 540 injector ports for the three runs. However, TBA was above its regulatory limit at these locations for all three runs. To control TBA, more injection ports were required. However, as shown above, additional injection ports increased the bromate concentration above its regulatory limit. Therefore, the experimental HiPOx system was not fully successful with this atypical water at the chosen oxidant doses.

A model calculation is presented that uses many simplifying assumptions to show that this HiPOx system may have been fully successful at this location under the chosen oxidant doses if the influent bromide concentration was 0.56 mg/L, or less. Since a bromide concentration of 0.56 mg/L is still extremely high for a drinking water source, the HiPOx system appears to hold promise for destroying MTBE and its oxidative byproduct TBA while controlling bromate formation, even in waters that have high bromide concentrations. However, before application to other sites, pilot testing will be needed due to the uncertainty in performance resulting from source-water quality differences.

Appendix A contain the manufacturer's supporting data from other sites and data collected by the manufacturer during the demonstration runs described herein.

Table of Contents

Tables

Figures

Acknowledgments

The authors would like to acknowledge Albert Venosa who was Work Assignment Manager for this demonstration, Dr. Fran Kremer (USEPA) who oversaw the entire EPA / Port Hueneme project, Dr. Carl Enfield (USEPA) who was responsible for installing the wells that provided water to this project, Katherine Baylor (USEPA) who helped run the system, and Sam Hayes (USEPA) and Michael Elovitz (USEPA) who provided inhouse reviews of this research brief. The authors would also like to acknowledge Terry Applebury, Reid Bowman, and Doug Gustafson of Applied Process Technologies, Inc. (APT) for their help in determining the optimal operating conditions, for the set up of the unit before testing, and for supplying Appendix A. Finally, the authors would like to acknowledge Emmet Black (TetraTech EM Inc.) who operated and sampled the HiPOx unit.

Due to lack of funds at the time of this technology's scheduled testing, a CRADA agreement between the USEPA and APT was created where APT supplied the USEPA with the funding necessary to cover the analytical costs of this project (approximately $7K). The USEPA used the funds through its contractor (TetraTech) who ran the study, collected the samples, shipped the samples, paid for the analyses, and summarized the results. At no time did APT influence the results or the subsequent discussion. Please see Appendix A for APT's data and comments regarding this project.